

## Archimedes Crown Lab

Background Information: Eureka! He found it! What did he find, who found it, how did he find it? All these questions can be answered looking at one man—Archimedes.

Archimedes, unquestionably one of the greatest mathematicians of all time, discovered the principle of buoyancy. He was born in Syracuse on the island of Sicily in 287 BC. He became known for his mechanical inventions used in times of war, yet, he was more famous for his passionate love of geometry. Often, he would forget to eat or drink, as he was so fixated on mathematical problems. He would be carried to the bathtub kicking and screaming because it kept him from his theorems; and so he would draw mathematical figures in the water to keep his obsession going. It was out of his bathtub that he so famously leaped and ran naked through the streets of his native city shouting "Eureka, Eureka", which means "I have found it, I have found it". What he found was that his body, when submerged in water, caused water to rise and that he was, at the same time, buoyed up by the water. Mathematically, he found that the upward, buoyant force on an object in water is equal to the weight of the water that is displaced by the object. This is called Archimedes Principle of Buoyancy.

Archimedes' discovery was important in uncovering whether a gold crown commissioned by King Hieronymus, the ruler of Syracuse at the time, had been adulterated with a quantity of silver. The crown was intended to celebrate the gods, yet Hieronymus was immediately suspicious that it was not entirely made of gold and so he asked Archimedes to confirm its contents. Archimedes struggled to find an answer for the King; it was merely accidental that he came across the answer while in the bath.

Though it is difficult to know all that much about Archimedes because he lived so long ago; most of what we do know comes from Vitruvius, a Roman architect, who said that to discover the contents of the crown, Archimedes immersed a lump of silver and a lump of gold into a container of water and saw that a certain volume of water overflowed from each lump. After immersing the crown in water, he noted that more water overflowed than the gold and less than the silver confirming it was of mixed breed. The craftsmen admitted his dishonesty in shame.

(Since pennies were minted in different years, they might have been made with different alloys and therefore have different densities.)

DEFINE:

Alloy- \_\_\_\_\_

Buoyancy- \_\_\_\_\_

**Question:** Are all pennies made of the same substance and will all pennies have the same density? Do pennies before 1980 have a different density than pennies after 1980?

**Hypothesis** (with supporting fact): If \_\_\_\_\_

then, \_\_\_\_\_

because, \_\_\_\_\_.

**Variables:**

Manipulated: \_\_\_\_\_

Responding: \_\_\_\_\_

Controlled: \_\_\_\_\_

**Materials:** 5 pre-1982 pennies, 5 post-1982 pennies, triple beam balance, graduated cylinder

**Procedure:**

1. Using the triple beam balance, measure the pre and post-1982 pennies and record the mass in grams.
2. Fill a graduated cylinder to a certain point with water and drop the pre- 1982 pennies in to see if the volume rises. Record the volume before and after.
3. Then drop the post-1982 pennies in the graduated cylinder. Record the volume.
4. Find the density of the pennies. Show all of your work in the data table below.

**Data Table: Mass, Volume and Density of Pre & Post 1982 pennies**

YEARS	MASS (grams)	VOLUME mL.		DENSITY (g/mL)
Pre 1982		Water only		
		Water and penny		
		Penny only		
Post 1982		Water only		
		Water and penny		
		Penny only		

Create a bar graph that shows your data with the year vs. density in your journal.  
Don't forget to add a title, label X&Y axes with units.

**Analysis:**

Paragraph#1

RESTATE& ANSWER-Are all pennies made of the same substance and will all pennies have the same density? Do pennies before 1980 have a different density than pennies after 1980? \_\_\_\_\_

\_\_\_\_\_

CITE data from table.

\_\_\_\_\_

\_\_\_\_\_

EXPLAIN what you data suggest.

\_\_\_\_\_

\_\_\_\_\_

Paragraph#2

RESTATE& ANSWER-Does your data support the information on the website?

\_\_\_\_\_

\_\_\_\_\_

CITE data from the website.

\_\_\_\_\_

\_\_\_\_\_

EXPLAIN how the information on the website support your data & hypothesis.

\_\_\_\_\_

\_\_\_\_\_